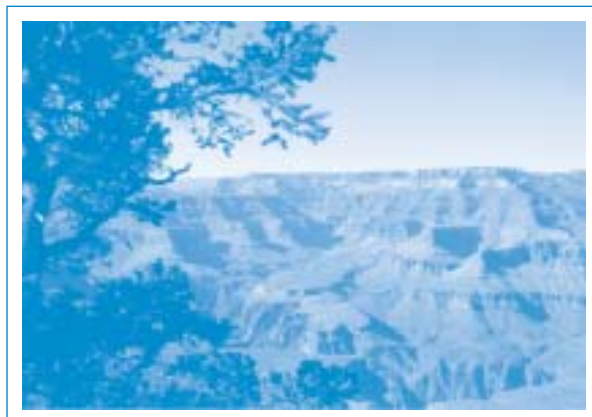


March 2003

RESEARCH IMPLEMENTATION REPORT

Arizona Transportation Research Center



ARIZONA DEPARTMENT OF
TRANSPORTATION



Welcome

The Arizona Transportation Research Center (ATRC) is charged with directing the Arizona Department of Transportation (ADOT) research program. An integral part of a successful research program is implementation of research results. This is ATRC's first report on research implementation. As this is the first such report by ATRC we have taken a look back at research completed during the past three years. We plan to continue publishing such reports annually.

Our research program is designed to help bring about ADOT's vision to be "the standard of excellence for transportation systems and services" and to assist in meeting the ADOT mission to "provide a safe efficient transportation system together with the means of revenue collection and licensing for Arizona." It is equally important to conduct high quality research work and to effectively implement the results of that work. Implementation may range from initiating dramatic changes in a construction or operations program to confirming that no changes in an existing strategy are needed. Either way, it's important to evaluate and learn from the results of all research studies. If this step is not taken consistently there is a good chance that valuable ideas and information will be left on the shelf.

Forty-four research projects with a total budget exceeding three million dollars were completed in calendar years 2000, 2001 and 2002. The accomplishments, success stories, and results stemming from these projects are addressed in this report. This report is aimed at communicating further the information gathered and lessons learned from this research. It highlights selected studies and provides an overview of lessons learned and implementation achievements. A complete list of research completed during the past three years is included in an appendix.

Frank T. Darmiento, P.E., Manager

Arizona Transportation Research Center
2739 East Washington Street
mail: 206 S. 17th Ave., Mail Drop 075R
Phoenix AZ 85007-3213
602 712 3134
fdarmiento@dot.state.az.us

Research: The relentless pursuit of excellence

CONTENTS

1

3	Who We Are and What We Do
3	Student Research Outreach
4	Research Implementation
4	Environment
5	Intelligent Transportation Systems (ITS)
6	Maintenance
6	Materials and Construction
7	Planning and Administration
8	Traffic and Safety
9	Appendix A — List of Research Projects Completed During 2000-2002, Arizona Transportation Research Center





The Arizona Department of Transportation (ADOT) conducts research on a wide range of transportation topics. The Department's research effort is administered by the Arizona Transportation Research Center (ATRC), which has immediate responsibility for the management and conduct of research. The ATRC research program is guided by two internal Research Councils that provide direction on research priorities, and a research Steering Committee. The Steering Committee provides policy guidance for the total research effort.

The Arizona Transportation Research Center is located at 2739 East Washington Street, Phoenix, Arizona. A list of ATRC staff is shown in Table 1.

ATRC manages the ADOT transportation research program, including conducting in-house research, coordinates the ADOT product evaluation program, houses and operates the ATRC Library, publishes the monthly Transportation Research Digest, and provides direct financial support for ADOT's Local Technical Assistance Program (LTAP).

Each year ATRC solicits research problems throughout ADOT. In meetings with individual offices or in Department-wide needs assessment meetings, ADOT personnel are asked to suggest research pertinent to their areas. ATRC also invites suggestions from academia, consultants, and industry. Research suggestions are solicited through personal contact, newsletters, electronic communications, and the Internet.

TABLE 1 — ATRC STAFF

Frank Darmiento, P.E. – Manager, ATRC
Rosendo Gutierrez, P.E. – Project Manager
Tom Kombe, Ph.D., P.E. – Project Manager
Steve Owen, P.E. – Project Manager
Larry Scofield, P.E. – Project Manager
John Semmens – Project Manager
Dale Steele – Librarian
Gloria Smith – Administrative Assistant
Eileen Pike – Administrative Assistant
Jessica Kirk – Engineering Assistant
Michael Zachary – Field Technician

The ATRC research program is currently grouped into seven emphasis areas. These areas are:

- Environment
- Structures
- Intelligent Transportation Systems
- Maintenance
- Materials and Construction
- Planning, Administration, Motor Vehicles, and Information Technology
- Traffic and Safety

New projects are assigned to one of these areas. A project manager is assigned to each project. Technical advisory committees are formed for each project to work with the project manager on developing work scopes, reviewing and guiding the progress of the research, and reviewing the final report.

Student Research Outreach

Part of the organizational culture at ATRC is an emphasis on use of university students wherever possible. We advertise, sponsor and host annually a workshop to maximize student involvement in conducting serious research studies. ATRC enthusiastically encourages future transportation professionals and we offer dozens of students the opportunity to learn first hand about the role of research and technology in the Nation's transportation system, and the variety of available transportation career options. The results have been high quality research that makes effective use of the ATRC research budget while providing valuable professional experience for students.



4 — Research Implementation

This section highlights some of the key research implementation activities resulting from research completed during the last three years. The discussion is grouped by research emphasis area.

During the past three years, 44 research projects have been completed under ATRC management. Appendix A includes a complete list of these projects. This section highlights a few of these projects and reviews implementation of the research results to date. The discussion is grouped by research emphasis area.



Environment

PROJECT 476 - VEHICLE EMISSION NOISE EVALUATION OF ARIZONA SPECIFIC STAMINA 2 AND TRAFFIC NOISE MODELS (TNM)

Project Cost: \$140,000

Summary: Performed evaluations for the Stamina 2 model and for the TNM used with Arizona and national reference energy means emissions levels (REMEL) case projects to develop Arizona specific REMELS to be used with TNM.

Implementation Status: The Arizona models can be used for state funded projects. Use for federal funded projects is subject to approval by the federal agencies. It could potentially save ADOT millions of dollars.

Most Unique Finding: The research showed that the difference between using the Arizona model and the national model was greater than expected.

PROJECT 490 - MODELING TRANSPORTATION NON-ATTAINMENT POLLUTANTS IN THE "HOT SPOT" REGION OF NORTH CENTRAL PHOENIX

Project Cost: \$13,000

Summary: The research applied a model for use in determining the effect of various meteorological and traffic conditions on the transport of carbon monoxide, ozone, and fine particulate matter in "Hot Spot" areas and identifying the effect of the new Highways 51 and 101 on the "Hot Spots."

Implementation Status: The results of this modeling provided a basis for assessing anticipated pollution transfer with the expansion of the Phoenix area urban freeway system.

Most Unique Finding: The model was surprisingly accurate, given the limited resources devoted to its development. This modeling can serve to predict pollution effects in future roadway location studies.

Intelligent Transportation Systems (ITS)

PROJECT 435 - INCIDENT MANAGEMENT SYSTEMS AND STRATEGIES

PROJECT 497 - STATEWIDE INCIDENT MANAGEMENT PLAN

Project Cost: \$175,000

The research provided by these projects created the guidelines for a traffic operations center manual and subsequently for ADOT's statewide Incident Management Plan (IMP). The IMP became a vital part of a statewide effort to provide better communications between appropriate government entities for better management of traffic incidents. A set of manuals and procedures was established for the effective management of emergency incidents. The current effective and cooperative interaction between agencies and local governments was established due to ADOT's development of the Arizona IMP in mid-2000.

The project manual defined procedures for cooperative action between agencies and this manual became the key common reference source for roadway incident management. Now, the various jurisdictions have a common understanding of their own responsibilities, areas and response role. Having a common manual for a uniform coordinated approach has clearly been better for each agency in planning and responding to any emergency incident.

Some results brought about from the recommendations of these two projects include:

- Passage of a quick clearance law.
- Use of Total Station survey technology to record incident data and to save investigation time and re-open the roadway more quickly, reducing congestion and secondary crashes.
- Initial use of aerial photogrammetry to record incident data.
- Creation of multi-agency training plans for proper use of vehicle warning and emergency lights in construction work zone areas.
- Creation of a Maricopa County roadway incident response team (Maricopa County REACT)
- Created a cooperative attitude between the various governments.
- It began the practice of shared resources among agencies
- Developed the concept and model for the current Department of Public Safety Freeway Service Patrol on the Phoenix freeway system.

One of the major benefits of the process was the engagement of the various agencies around a common concern. Through collaboration on this project all the stakeholders developed a consensus among the involved government agencies. The key ingredient generated was trust among agencies in mutual cooperation and operations.

This collaboration in exploring the research objectives not only provided a common plan from which to operate with maximum efficiency it created a coalition of like-minded agencies. These projects established the trust needed for an effective coalition to deal with other mutual concerns where previously there had been no structure or guide for such relationships.

In the period after completion of this research several state and federal advisories have triggered the tools for communication, interaction and response. These advisories included the response after the crisis of September 11, 2001. Because of this project Arizona was ready to respond effectively and has the basis for response to new Homeland Security measures.

PROJECT 447 - FIELD EVALUATION OF RHODES-ITMS**PROJECT 462 - RHODES - ITMS CORRIDOR CONTROL PROJECT****PROJECT 481 - FIELD TEST OF RHODES-ITMS RAMP METERING SYSTEMS****Project Cost: \$622,000**

Summary: The RHODES-ITMS model developed and later integrated both urban arterial and freeway corridor control schemes using real-time adaptive signal control and ramp metering strategies. Laboratory and field tests were conducted to refine the original models, to enhance traffic flow for both the freeway corridor and the intersecting arterial streets.

Implementation Status: The history of these projects has shown steady progress towards an incremental goal for a period of over ten years. During that period the goal has evolved to one of exploring the most practical and available adaptive control systems for traffic. The benefits that have accrued as a result of these projects include:

- The specific development and field testing of one of the three major adoptive control systems procedures that can serve the nation.
- RHODES has become the basis for research at several other sites including Tucson, Arizona and Seattle, Washington.

Most Unique Findings: The research results show RHODES to have the key elements and capabilities basic to the fundamental technology level to time signal systems. The initial cost of moving to the next level of signal control technology refinements may be more expensive than timed light systems. However, the advantage of using this system is that it can reduce delay time at intersections from 10 to 15 percent.

Maintenance

PROJECT 418 - MAINTENANCE MANAGEMENT SYSTEM PROCEDURES**Project Cost: \$135,000**

Summary: This research resulted in a recommendation for the preferred maintenance management system (MMS) and provided an implementation plan for integrating the MMS into ADOT practices.

Implementation Status: No level of service technique existed prior to the research. Before completion of the research, full implementation of the recommendations on the level of services standards and system were in place.

Most Unique Finding: A public survey conducted revealed that the public regarded ADOT maintenance very favorably and additionally that the public was willing to pay more to assure improvements to roadways.



Materials and Construction

PROJECT 404 - PAVEMENT PERFORMANCE EVALUATION AND REHABILITATION STRATEGIES**Project Cost: \$149,000**

Summary: This research resulted in the preparation of an economic model that assesses the value of ADOT Pavement Management Strategies (PMS) and develops strategies and software techniques to evaluate future improvements considered for the PMS.

Implementation Status: The results that were developed by these tests have been implemented in ADOT practices. Several overlay techniques that were examined are now in use.

Planning and Administration

PROJECT 477 - HIGHWAY COST ALLOCATION STUDY MODEL UPDATE

Project Cost: \$30,000

Summary: The purpose of the study was to obtain up-to-date data on vehicles, traffic, and highway expenditures. This information was used to recalibrate the highway cost allocation model to reflect changes in tax rates and traffic since the first highway cost allocation study was completed in 1993.

Implementation Status: A new simplified model was developed and implemented. A user's manual was written and several members of the Financial Management Services Section staff were trained to use the cost allocation model.

Most unique finding: This approach saved ADOT several hundred thousand dollars—the typical cost to perform a cost allocation study. An effective model for estimating vehicle cost responsibility was developed using a personal computer spreadsheet.



PROJECT 465 - EFFECTIVENESS OF VIDEOCONFERENCING

Project Cost: \$148,000

This project explored the effectiveness of videoconferencing to determine if videoconferencing technology can reduce travel costs and enhance effective and efficient use of staff time for ADOT. The project was divided into two phases. Phase 1 began in February 1997 and ended in November 1998. The first phase entailed research studies into the impacts experienced by other organizations that have deployed videoconferencing technology (VCT) for internal use. From the findings of Phase 1, we know that VCT offers three major contributions to today's business world: (1) Communications between geographically remote parties become much easier with much less time and money, (2) More people can attend the meetings and get direct information to participate in the decision making process, and (3) VCT changes the whole culture of the employee training format. More people can get trained for the same amount of money. There is little doubt that the use of videoconferencing will increase as the technology improves and bandwidth limitations are overcome.

Based on the findings of Phase 1, three sets of VCT equipment were bought and installed at three ADOT locations: Flagstaff, Phoenix, and Tucson. Phase 2 of the research—the post-pilot test report—started in August, 1999. The purpose of this phase was to measure the use of videoconferencing among employees in the ADOT organization. Its first objective was to identify all costs associated with installing, maintaining, and operating the system. The second was to obtain direct responses from the ADOT employee participants to calculate the "Hard Savings" such as the savings from travel expenses, vehicle expenses and personal time. The third was to obtain the direct responses from ADOT VCT participants to find out what "Soft Benefits," such as (a) increased employee involvement in decision making, (b) the perceived reduced accident rate and stress due to traveling, (c) the improved communication quality, and (d) the better use of staff time on work.

As a result of this research ADOT continues to operate the three videoconference sites. The Phoenix site is used on a regular basis for the WASHTO-X program. The WASHTO-X Program is a two-year pooled fund research study providing members of the Western Association of State Highway and Transportation Officials and the associated field offices of the Federal Highway Administration the opportunity to conduct informal information exchanges among transportation personnel through video-communications.

SPR 484 - COMPARE RURAL VS. URBAN DISTRIBUTIONS OF TRAFFIC AND HIGHWAY EXPENDITURES

Project Cost: \$57,000

Summary: The study results compiled data on highway system use in order to evaluate allocation of money from the Highway User Revenue Funds (HURF). Traffic and highway use data were compared with highway resources and HURF allocations.

Implementation Status: The State Transportation Board requested this study. The study results were used to successfully resolve concerns among highway user representatives in urban Maricopa County.

Most Unique Finding: The urban areas of Maricopa County currently receive a greater share of HURF than might be allocated by simply considering traffic count data.



Traffic and Safety

PROJECT 467 - EFFECTIVE COUNTERMEASURES TO REDUCE ACCIDENTS IN WORK ZONES

Project Cost: \$30,000

Summary: An analysis was performed of the last five years of work zone accidents in Arizona to determine the trends, patterns, and identify circumstances in work zone safety. The research measured the effectiveness of various countermeasures and prepared a state-of-the-practice report on effective countermeasures to reduce accidents in work zones.

Implementation Status: Nine work zone traffic accidents had yielded 9 deaths. The recommendations of the report generated a major awareness in several divisions to focus on safety features in work zones resulting in a major change in operations.

Most Unique Finding: The ADOT Motor Vehicle Division recognized a need for public education on work zone safety.

PROJECT 492 - TRAFFIC GROWTH IN ARIZONA

Project Cost: \$ 100,000

Summary: This research resulted in the development of a plan for the systematic, orderly, and consistent collection of traffic data:

Implementation Status: The system for collection of data has begun, involving a variety of ADOT divisions. Further studies based on this project are being launched.

Most Unique Finding: Many sections across ADOT endorsed the need for a central, common data warehouse.

List of Research Projects Completed During 2000-2002

ARIZONA TRANSPORTATION RESEARCH CENTER

PROJECT #	PROJECT TITLE
404	Pavement Performance Evaluation/Rehabilitation Strategies Effectiveness
418	Maintenance Management System Procedures
447	Field Evaluation of RHODES-ITMS
455	Development of New Pavement Design Equivalent Single Axle Load (ESAL)
461	Procedures for Winter Storm Maintenance Operations
462	RHODES – ITMS Corridor Control Project
465(2)	Effectiveness of Videoconferencing: Phase 2--Post-Pilot Test Report
467	Effective Countermeasures to Reduce Accidents in Work Zones
468	Accelerated Pavement Testing
473(1)	Intelligent Vehicle Initiative (IVI) Research: Phase 1
473(2)	Intelligent Vehicle Initiative (IVI) Research: Phase 2
475(1)	The Value of Arizona's State Highway System: A Corporate-Style Financial Analysis
475(2)	The Value of the RARF Freeway System: A Corporate-Style Financial Analysis
476	Vehicle Emission Noise Evaluation
477(1)	Highway Cost Allocation Study Model Update: Phase 1—Development of a Simplified Model
477(2)	Highway Cost Allocation Study Model Update: Phase 2—Refinement of the Simplified Model
477(3)	Highway Cost Allocation Study Model Update: Phase 3—Implementation of the Simplified Model
478	The Prospects for Tort Reform in Arizona
481	Field Test of RHODES – ITMS-MILOS Ramp Metering Systems
483	Optimization of Drilled Shaft Group Spacing
484(1)	Arizona Highway Users Origin and Destination Survey
484(2)	Traffic and Expenditures on Arizona State Highways
485	Arizona Statewide Alternate Route Plan
487	Survey of Highway Freight-Hauling: State Regulatory Practices, Trucker Perceptions, and Truck Traffic Volumes
488	Anti-Pollution Technologies for Vehicles: Can Non-Attainment Areas Reach Attainment Via a Technological “Fix?”
489	Survey of Methods and Practices of High Performing State Highway Agencies
490	Modeling the Transport of Non-Attainment Pollutants
492	Enhancing ADOT Traffic Data Resources
497	Statewide Incident Management Plan
501	Evaluation of Modified Single Point Urban Interchange
502(1)	ADOT Uses for Virtual Private Networking Technology: Phase 1 – Pre-Pilot Test Report
502(2)	ADOT Uses for Virtual Private Networking Technology: Phase 2 – Final Test Report
503	“State-of-the-Art” Report on Non-Traditional Traffic Counting Methods
504	Arizona Local Government Safety Project Analysis Model
506	What Is the Best Way to Address Environmental Justice Issues?
507(1)	Survey of Futurist Trends
507(2)	Movements in Land-use Regulations
507(3)	Tourism's Impact on Future Transportation Needs
507(4)	Technology and Intelligent Transportation Systems (ITS): The Implications for Future Transportation
513	Alternate Routing Interactive System (ARIS)
516	Impact of Highways on Property Values: Case Study of the Superstition Freeway Corridor
523	Improved Mechanism for Stakeholder's Environmental Education
529	Arizona Department of Transportation Information Data Warehouse Application: Evaluation of HERS/ST as a Data Source Component
531	Evaluation of Design of Temporary Concrete Barriers

ARIZONA DEPARTMENT OF TRANSPORTATION

Arizona Transportation Research Center
2739 East Washington Street
Phoenix, Arizona 85034-1422

Mailing address:
Arizona Transportation Research Center
206 S. 17th Ave., Mail Drop 075R
Phoenix AZ 85007-3213

Phone: 602-712-3134
Fax: 602-712-3400
E-mail: fdarmiento@dot.state.az.us
Internet: www.dot.state.az.us/about/atrc/index.htm

